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(71)(72) Applicant and Inventor: MERAGI, Ali, Reza [GB/GB]; 10 Thornton Avenue, West Drayton, Uxbridge, Middlesex UB7 9JT (GB).

(74) Agent: SAUNDERS & DOLLEYMORE; 9 Rickmansworth Road, Watford, Hertfordshire WD1 7HE (GB).

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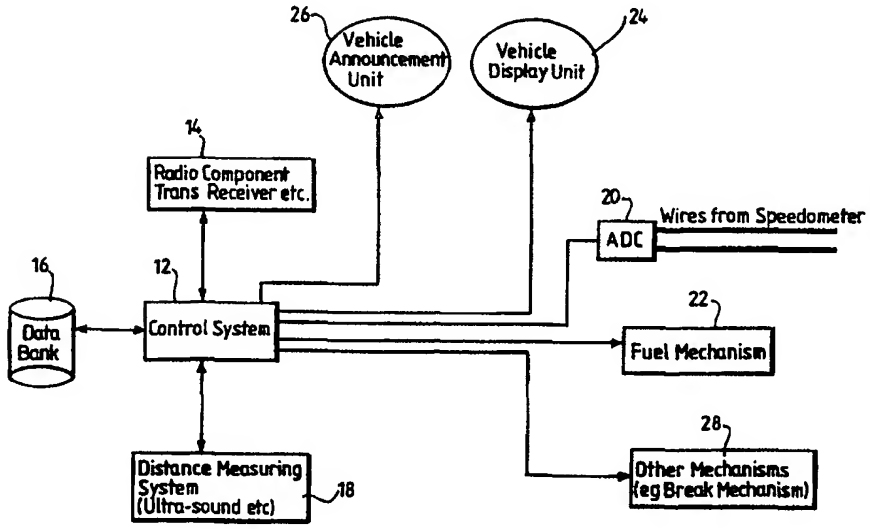
(54) Title: VEHICLE MONITORING AND CONTROL SYSTEMS



(57) Abstract

A vehicle monitoring and control system has a base station (8) having a radio transmitter and receiver. A plurality of motor vehicles (10) each have a radio transmitter and receiver tuned to communicate with the radio transmitter and receiver of the base station (8). Each vehicle has a central control system (12), a databank (16), audio and visual information indicators (24, 26), fuel and brake controlling mechanisms (22, 28) and vehicle performance monitors (18, 20). The central control system (12) responds to the base station to provide data from the databank (16) and the information indicators (24, 26). The system (12) is operable to control the fuel and brake controlling mechanisms (22, 28) both in response to the output of the performance monitors (18, 20) and in response to commands from the base station (8).

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VEHICLE MONITORING AND CONTROL SYSTEMS

The present invention relates to vehicle monitoring and control systems.

Commercial vehicles such as trucks and articulated lorries carry a tachograph which is a device which records such vehicle parameters as speed and driving time. At regular intervals, the recorded data is extract and analysed.

As such, the system only provides a historical record of the vehicles activity.

It is an object of the invention to provide an improved vehicle monitoring and control system.

According to the present invention there is provided a vehicle monitoring and control system comprising a base station having a radio transmitter and receiver, a plurality of motor vehicles each having a radio transmitter and receiver tuned to communicate with the radio transmitter and receiver of the base station, each vehicle having a central control system, a data bank and at least one of each of the following groups, information indicators, vehicle controlling mechanisms and vehicle performance monitors, the central control system responding to the base station to provide data from the databank and the information indicators and being operable to control the vehicle controlling mechanisms both in response to the performance monitors and the base station.

A card reader associated with each central control system is arranged to respond to service history cards and cards containing official data to cause said central control system to store the data read therefrom into the databank. Means may be provided to simultaneously transmit the stored data to the base station. The databank may be protected by a unique code so that data can only be read from the databank in response to the generation of the unique code.

Means may be provided allowing the central control systems of adjacent cars to communicate with each other for implementing mutual safety parameters.

The information indicators may comprise display and audible announcement units.

The control mechanism may comprise fuel and brake control mechanisms.

The vehicle performance monitors may comprise speed and distance monitors.

A vehicle monitoring and control system will now be described, by way of example, with reference to the accompany diagrammatic drawings, in which:

Figure 1 is a schematic of the system;

Figure 2 is a side elevation of a vehicle of the system;

Figure 3 is a block diagram of that part of the system within the vehicle; and

Figure 4 is a block diagram showing the card reader and associated connections within the system.

The advent of mobile telephone systems provides the necessary technology for each road vehicle in the country to be equipped with a radio transmitter/receiver so that data can be transferred between the vehicle and a centralised control and monitoring system. Figure 1 shows an example of such a system which, has at its centre, a management system in the form of a police central control and monitoring unit PCMU 2. The structure of this unit is generally similar to the network management centre of a mobile communication system and can, in fact, comprise the network management centre of an existing mobile communication system. The country as a whole is divided into a plurality of regions with each region containing a police regional control and monitoring unit PRMU 4. Again, the structure of this unit is generally similar to a regional operation and maintenance centre of a mobile communication system. The PRMU 4 controls a base station controller BCS 6, which in turn is linked to a base transmitter/receiver station BTS 8. Each BTS 8 is linked to all vehicles 10 located within its domain (eg a section of the area bounded by and including the circular M25 motorway

extending around the London metropolis).

Each vehicle, as shown in Figure 2, is equipped with a central control system 12 which is linked to the local BTS 8 by a radio transmitter/receiver 14.

Also located within the vehicle 10 are a number of data providing devices and control systems, for example, data card readers and disk drives. Thus, as shown in Figure 3, the vehicle 10 has a databank 16 which is accessible by the control system. The databank 10 is protected by a key code so that it can only be accessed from the PCMU 2 when the correct code is generated. This prevents unauthorised access by the owner of the vehicle or any other non-official party. The databank may store a variety of data from the vehicle details (including engine number and chassis number) to official data regarding MOT tests and road tax which may only be input either from the PCMU 2 or locally with the aid of a card reader. Other data, such as parking violation data, transmitted from an adjacent parking meter upon expiry of the parking time or a speed limit infraction from a local speed trap may also be entered into the databank under control of the control system 12. Such data can, in due course, be recovered by the PCMU 2 and appropriate sanctions applied (such as the automatic generation and dispatch to the owner of penalty tickets). It will be appreciated that one advantage of the system is that it can operate in a real time mode.

The vehicle 10 may also include an ultrasonic distance measuring system 18 for measuring the distance to the vehicle immediately ahead, behind and on both sides, a vehicle speed coupling system 20 (eg an analog to digital converter connected to the vehicle tacho generator), a fuel control mechanism 22 for variably restricting the rate of flow of fuel (eg by a factor of 20%) to the engine, and vehicle display and announcement units 26, 24 all of which are coupled to the control system 12. Other mechanisms for controlling the vehicle such as an auxiliary braking control system 28 may also be provided and coupled to the central control system 12.

The central control system provides not only for internal management of the vehicle 10

but also for external management of the vehicle.

As an example of internal management, the distance measuring system 18 may indicate that the vehicle immediately ahead is too close after computing the distance measured, the speed obtained from the unit 20 and a speed ratio/distance reference table (not shown). The table may be accessed from a local BTS when the vehicle enters the region covered by the BTS so that the table can take into account local road, weather and traffic conditions. If the vehicle speed is too high in relation to the vehicle in front, the central control system 12 will cause the vehicle announcement unit 24 and vehicle display unit 26 to communicate this to the driver.

As an option, at the same time, the central control system may activate the fuel control mechanism 22 and/or the auxiliary braking control system.

As an example of external management, the PCMU 12 will issue a signal to all vehicles in a particular domain that fog exists and cause the central control system 12 of each vehicle to announce the fact on the vehicle announcement system together with a mandatory speed limit and mandatory spacing between vehicles. At the same time, the vehicle control system 12 will activate the fuel control mechanism 22 and the auxiliary braking system 28 to bring the vehicle speed down to below the mandatory limit or at least inhibit the rise of the vehicle speed beyond the mandatory limit.

As a further example, the PCMU 12 may request the control system 12 of a particular vehicle 10 to supply partial data from its databank 16 eg does the vehicle have a valid MOT certificate and road tax licence. The PCMU 12 has a memory which generally stores all the main data but there is a need to periodically compare the main data stored in the PCMU 12 with that stored in the databank to check for errors or tampering. Instead of the data being requested direct from the PCMU 12, it may be requested locally eg at the side of the vehicle by authorised police personnel using hand held communicators. Also the vehicle may be supplied with a keyboard (not shown) so that the driver of the vehicle can himself access the data in the databank but on a read only basis.

The control system 12 is capable of reading magnetic cards. For example, it may read a magnetic card related to car service history and in response thereto update its databank accordingly. It also supports a drive (eg a floppy drive) for loading and storing information. The databank 16 stores unique vehicle identification code which can be transmitted upon request (eg by a BTS or a policeman's hand-held monitoring device). Similar codes as those used for mobile communications may be utilised. For example, one ID code may be necessary for the vehicle and the other for the person who drives the vehicle (eg carried within the vehicle switch). A temporary memory stores some other types of data such as domain speed limits.

The system 12 will be fed by the vehicle battery. An emergency back up battery is also provided.

The card reader 40 of the system is shown in Figure 4. The card reader 40 can read a card 42 with a magnetic strip by swiping the card through the reader 40.

The card reader 40 has two outputs, a first of which supplies a unique code read out from the card 42 to a comparator 44. The comparator 44 compares the code received with the code stored in a memory 46 and, if equality is detected, it activates an inhibitor 48. The inhibitor 48, when actuated, permits data from the second output of the reader 40 to be transmitted to, and stored in, the databank 16. The second output from the reader 40 is also fed to the transmitter 14A of the transmitter/receiver 14 for onward transmission to the base station 8. When the base station 8 requires data from the databank 16, it transmits the unique vehicle code to the comparator 44 via the receiver 14B. This then allows access to the databank 16 via the activated inhibitor 48. Data selected from the databank 16 is then outputted through the inhibitor 48 to the transmitter 14A.

The system described thus has very many advantages. In particular:

1. It will be able to set a speed limit within a traffic domain for the cars entering a

domain. The speed of a car in a traffic domain will not exceed a certain limit no matter how hard the accelerator is pressed. The speed limit for a domain will be dictated by the base stations in that domain. This is particularly useful near schools and within narrow alleyways.

2. The distance between the cars within a traffic domain can be controlled (by the local base station) according to the domain parameters (speed, weather, etc). The distance parameter is transmitted to vehicles in the domain. The appropriate distance is observed mainly by the way of negotiation between the control systems of adjacent vehicles. (Therefore note that two cars installed with such devices provide better safety for the drivers.)

3. The vehicle only transmits data if there is a request to do so (from other devices eg BTSs, other vehicles, police hand-held devices, etc).

4. Upon request, the vehicle 10 will be able to transmit the vehicle speed. This is the speed as seen by the driver of the vehicle (no driver excuses). A more realistic speed reading will be the one taken in a period of x minutes (average speed).

5. Upon request, the vehicle 10 will be able to transmit the vehicle registration number, other ID codes and other types of data.

6. After obtaining an MOT certificate or a road fund license the data is transmitted to police central control and monitoring unit and the vehicle databank is updated accordingly. The same is true for any other legal documentation confirming that the vehicle complies with legal requirements.

7. Upon request, the vehicle 10 will be able to transmit the vehicle license and legal compliance (eg MOT) status. For example, this data will be used to compare with the data already stored within the PCMU 2.

8. Other types of data such as a car service history, previous owners, etc are also

stored in both vehicle control system databank and police central control and monitoring unit. The PCMU 2 can keep a record of the vehicle mileage and so reduce the risk of unscrupulous sellers "clocking" or reducing the mileage on the vehicle mileage recorder.

9. Only a driver with a correct code (eg located within the car key) may switch the vehicle on.

10. It may be made very difficult to alter functionality of a vehicle system (also alternations could be made illegal).

11. Micro-base stations may be used to set and monitor speed limits on the smaller roads and heavy populated areas (or near children playgrounds, etc).

12. Near the pedestrian crossing (or traffic lights) when the light is red (green for the pedestrian) the central control system 12 stops the car (if the driver does not attempt to stop).

13. An accident or a sudden shock (break) to the vehicle may send an alarm to the local BTS and consequently the traffic in the vicinity must be ordered to slow down appropriately or come to a halt.

14. The vehicle security alarm system will be connected to the control system. Therefore a break-in will generate an alarm at the PRMU 2.

15. The PCMU 2 will be able to issue a penalty ticket, warning, etc upon misconduct of a vehicle (driver). For example, a ticket will be issued automatically if the vehicle speed goes over a specified limit indicated by signs (not broadcast by base station but not enforced by the vehicles control system). Another example would be a car parked in an illegal location, which causes a ticket to be issued and personnel to be dispatched to clamp the vehicle. In addition, the PRMU 4 or PCMU 2 can issue a command to disable the vehicle (eg by setting the speed to zero or locking the brakes) for example in the case of a stolen vehicle. Instead of

disabling the vehicle a very low (uncomfortable) speed limit may be imposed.

It will thus be seen that using the system described, it is possible to improve the state of the current vehicle monitoring and control in a step by step manner to create a smooth running traffic and regain the revenue lost in the form of non-payment of tax, MOT, etc. In order to implement the above process, at first a simple system may be implemented to report the speed of the vehicles to a central monitoring unit as soon as the speed exceeds a certain value (eg for more than 5 minutes). A penalty ticket may be issued accordingly. This by itself can bring extra revenue for the government. At the next stage of implementation items such as tax, MOT and mileage monitoring, service history monitoring, speed control, parking location control, etc can be included. The distance measurement monitoring can be a very simple device and drivers (if the price is right) may be convinced to arm their vehicle with such a device for their own safety.

The system described can be implemented originally in the regions of heavy traffic and eventually distributed to other regions. Currently, most of the population is covered by mobile telephony and if the current facilities are used for vehicle radio part communications, there will be no escape for offenders. The current technological achievements allow a system to be built in a short time which is easy to install, profitable and at the same time not too easy to hack for ordinary people. However, a simple analysis can show that the safety aspect is a main advantage.

To implement the methods described, it is desirable that the government should promulgate and enforce laws that every vehicle in the country should be armed with a control system as described here. This would be feasible if the implementation of such laws occurs in various phases. As an example, the first, and perhaps the easiest phase (step 1), should be to attach a reader to a vehicle capable of reading tax and MOT and other data (service history, etc) and reporting (using mobile communications) to the central management system. Also, reporting the expiration dates of the tax/MOT (if a vehicle fails to report this further investigation may be carried out as to the reason for this failure). In the next phases (steps 2, 3,

etc) other facilities may be enforced such as the addition of a vehicle control system capable of managing the fuel injection system and brakes of the vehicle.

An advantage of the described method is the fact that it can use existing mobile network infrastructure already provided by mobile communications operators to provide total vehicle management. Here we define the term "Total Vehicle Management" as covering the following items:

- Administration of a vehicle: eg tax, MOT, warnings, changing car registration, control of car parking and automatic issuing of penalty tickets, etc.
- Management of vehicle movements: eg monitoring and control of speed and general vehicle movements in residential areas at traffic lights, pedestrian crossings, in motorways, etc using radio communications.
- Local Vehicle Management: eg management of fuel injection, break mechanism, distance from the nearby objects, etc via a central control system. Local Vehicle Management is currently being researched by a number of car manufacturers, etc.

As opposed to current methods which are being researched by large car manufacturers that require modification to roads, etc (and they do not provide Total Vehicle Management), the described method will use the present capabilities of the mobile communications infrastructure to communicate and therefore to manage a vehicle. This means little or no new hardware is required for the task. The mobile operators should allow necessary management of the vehicle control systems (commands, data collection, etc) to take place using their mobile network infrastructure and Network Management Centres. The main modifications to their system will be at software level. It should be easily possible to integrate specific vehicle management software with the existing software at various management levels. The vehicle management software distributed over various network elements of the mobile network should be using a new protocol (to be defined) to communicate with the vehicle (command/response).

CLAIMS

1. A vehicle monitoring and control system comprising a base station having a transmitter and receiver, a plurality of motor vehicles each having a transmitter and receiver tuned to communicate with the transmitter and receiver of the base station, each vehicle having a central control system, a data bank and at least one of each of the following groups, information indicators, vehicle controlling mechanisms and vehicle performance monitors, the central control system responding to the base station to provide data from the databank and the information indicators and being operable to control the vehicle controlling mechanisms both in response to the performance monitors and the base station.

2. A system according to Claim 1, including a data carrier reader associated with each central control system, said reader responds to data carriers carrying service history and containing official data to cause said central control system to store the data read therefrom into the databank.

3. A system according to Claim 1, wherein each said reader is a card reader and said data carrier is a data card.

4. A system according to Claim 2 or to Claim 3, including means responsive to the reader to cause the transmitter to transmit, the data being read,to the base station for storage thereat.

5. A system according to any preceding claim, wherein each central control system includes an inhibitor , which when not activated, inhibits access to the data store, a memory for storing a code unique to each central data system and a comparator for receiving a code transmitted thereto, comparing it with the code in the memory and responsive to received code being identical to the code stored in the memory to activate the inhibitor.

6. A system according to any preceding claim, wherein each car has an intercar communicator which is capable of communicating with the intercar communicator of an

adjacent car or cars and when activated interconnects respective central control systems to organise and implement mutual safety parameters.

7. A system according to any preceding claim, wherein each said information indicator comprises a visual display unit.

8. A system according to any preceding claim, wherein each said information indicator comprises an audible announcement unit.

9. A system according to any preceding claim, wherein the controlling mechanisms comprise a fuel control mechanism for controlling the rate of flow of fuel to the vehicle engine.

10. A system according to any preceding claim, wherein the controlling mechanisms comprise a breaking actuator for actuating the brakes of the vehicle.

11. A system according to any preceding claim, wherein vehicle performance monitors may comprise speed and distance monitors for producing speed and distance data related to the vehicle.

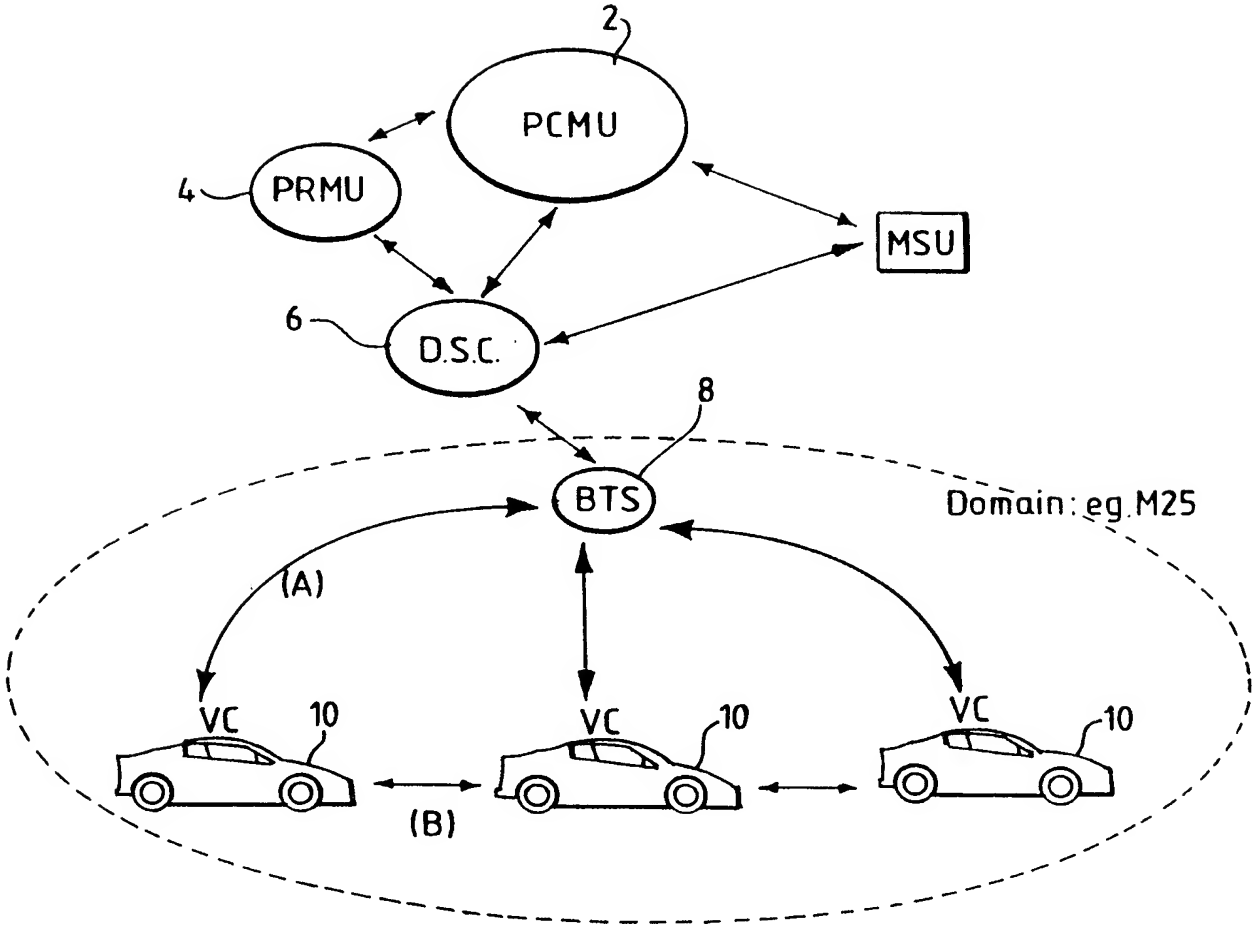
2
PCMU
4
PRMU
MSU
6
D.S.C.
8
BTS
Domain: eg. M25
(A)
VC
10
VC
10
VC
10
(B)

FIG.1.

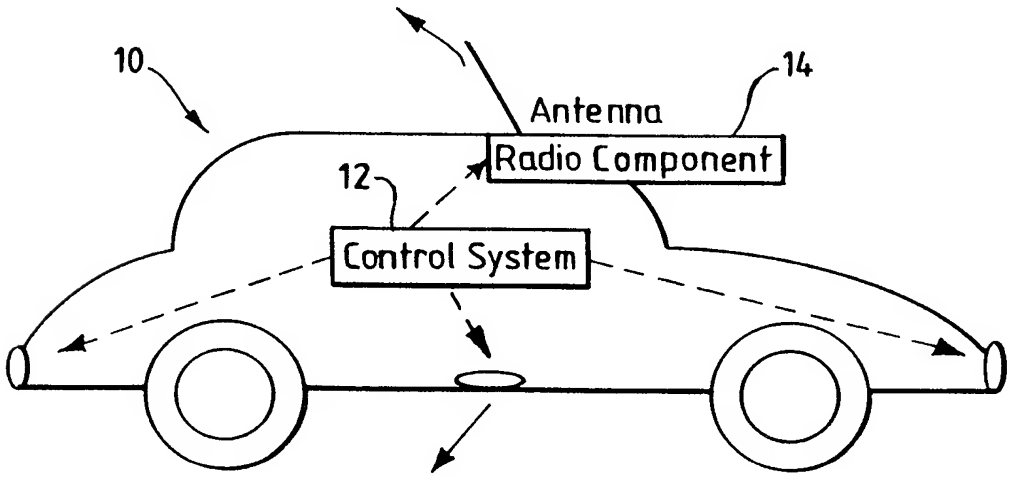
10
14
Antenna
Radio Component
12
Control System

FIG.2.

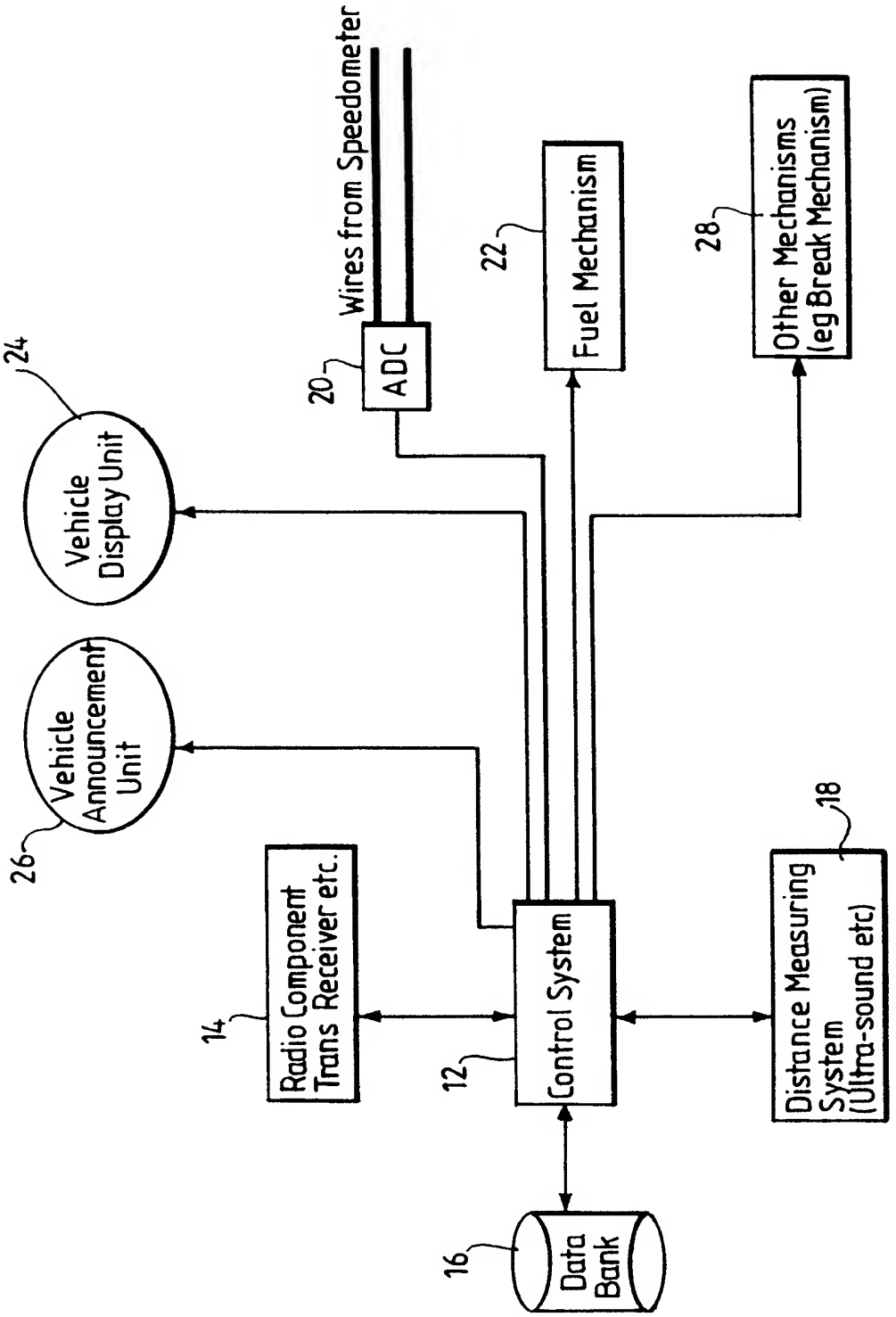
Wires from Speedometer
ADC
20
Fuel Mechanism
22
Other Mechanisms (eg Break Mechanism)
28
24
Vehicle Display Unit
Vehicle Announcement Unit
26
Radio Component Trans Receiver etc.
14
Control System
12
Distance Measuring System (Ultra-sound etc)
18
Data Bank
16

FIG.3.

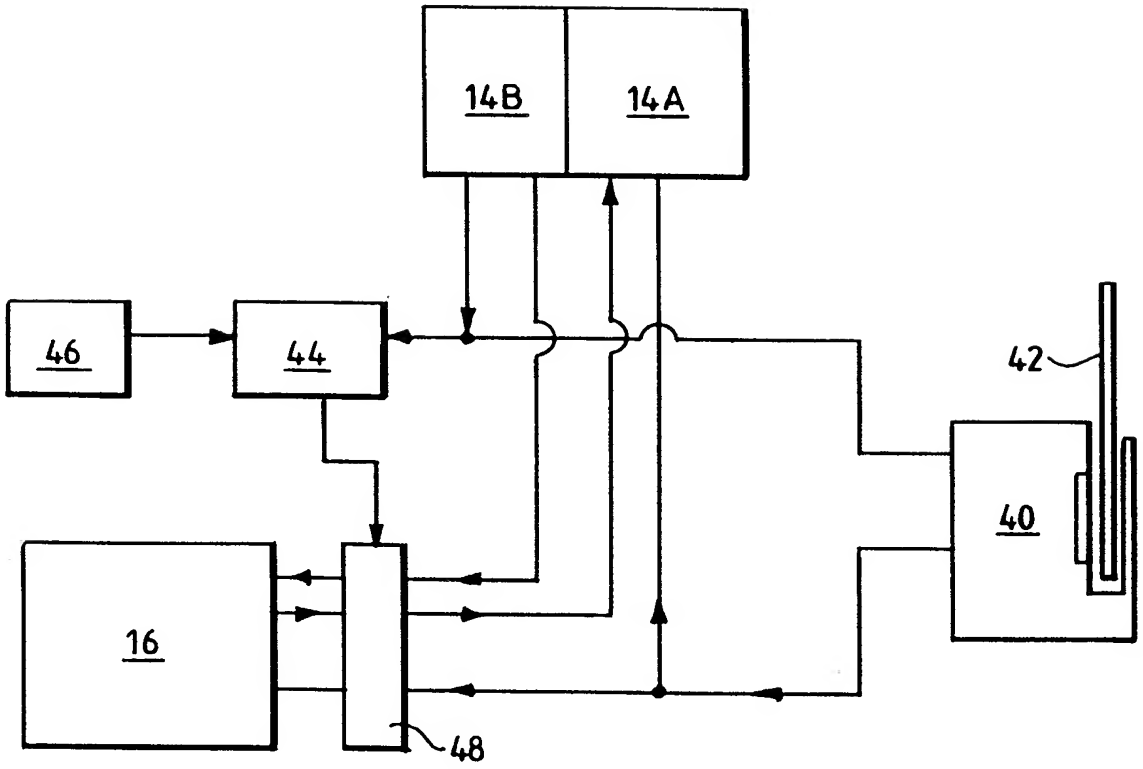

FIG.4.

INTERNATIONAL SEARCH REPORT

In ıtional Application No
PCT/GB 99/01049

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G07C5/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G07C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 97 13208 A (SCIENTIFIC ATLANTA ;HOUSER PETER B (US)) 10 April 1997 (1997-04-10) abstract page 3, line 28 - page 6, line 15 page 7, line 9 - page 19, line 21 page 25, line 20 - page 27, line 17 figures 1-3,5 ---	1-11
Y A	EP 0 745 959 A (FUJITSU LTD) 4 December 1996 (1996-12-04) abstract page 3, line 9 - page 5, line 6 page 6, line 3 - page 10, line 39 figures 1-12 ---	1-5,7,8, 11 9,10
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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13 July 1999	21/07/1999

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INTERNATIONAL SEARCH REPORT

Ir ıtional Application No
PCT/GB 99/01049

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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A	abstract page 3, line 4 - page 4, line 17 page 5, line 7 - page 8, line 26 page 10, line 10 - page 13, line 6 page 15, line 9 - line 23 claims; figures 1-7	1,3,7,8, 11
A	EP 0 292 811 A (MOTOROLA INC) 30 November 1988 (1988-11-30) abstract column 1, line 45 - column 2, last last column 4, line 53 - column 6, line 42 claims 1-5; figures 1,2	1
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INTERNATIONAL SEARCH REPORT

Information on patent family members

Ir ational Application No
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